Long-term Oncological Outcomes after Distal Pancreatectomy for Neuroendocrine Neoplasms: a Comparison between Minimally Invasive and Open Approach using a Propensity Score

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Background

Pancreatic neuroendocrine neoplasms (PanNEN) represent ideal entities for minimally invasive surgery. Aim of this study was to compare short-term postoperative outcomes, pathological findings and long-term oncological results of minimally invasive distal pancreatectomy (MIDP) and open distal pancreatectomy (ODP).

Materials and Methods

Patients who underwent ODP or MIDP for nonfunctioning (NF) PanNEN were retrospectively analyzed. Inverse probability of treatment weighting (IPTW) using propensity score (PS) was used to compare the outcomes of minimally invasive and open approach. PS was computed using a logistic regression model without variable selection. The variables included in the model were: age, sex, preoperative PET, tumor size, ASA (3-4 vs 1-2), splenectomy, Ki67 and N stage (**Figure 1**). A version of the PS without considering N in the model was also computed, since for outcomes related to surgery this information was not available. For comparison, models without IPWT were also computed.

Conclusions

Although MIDP seems to be associated with a lower number of resected LN, long-term survival is not influenced by the type of surgical approach. MIDP is advantageous in terms of postoperative complications and length of stay but prospective studies are needed to confirm the oncological quality of resection in this group of neoplasms.

Results (Click)

Overall, 131 patients with NF-PanNEN were included in the study: 84 underwent OPD, whereas 47 underwent MIDP. Median radiological diameter was 25 mm (interquartile range 18-45). Using IPTW, the rate of postoperative complications was significantly lower after MIDP (*P*=0.006) (**Table 1**). Postoperative length of stay was significantly shorter after MIDP compared to ODP (*P*<0.001) (**Table 2**), whereas the number of examined lymph nodes (ELN) was significantly higher after ODP in comparison to MIDP (*P*=0.007) (**Table 3**). Similar progression-free survival (PFS) (**Figure 2a**) and overall survival (OS) (**Figure 2b**) were reported for the two groups (*P*=0.695 and *P*=0.766, respectively).

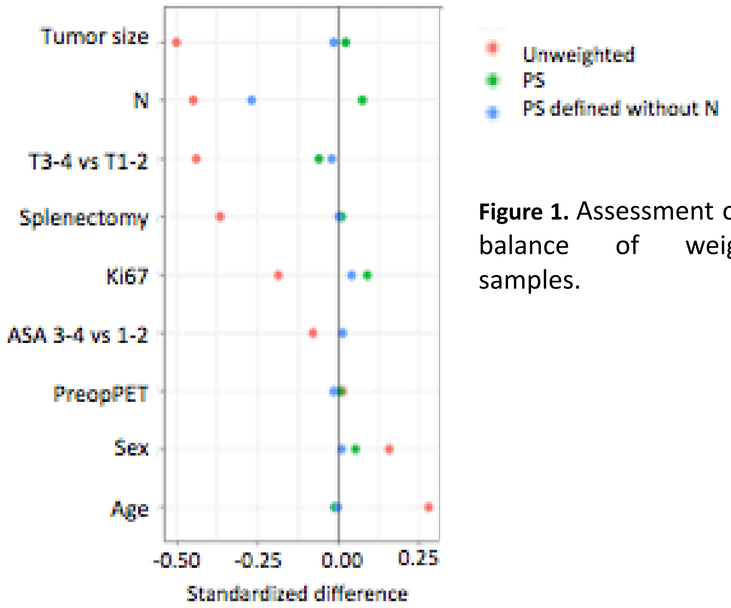

Figure 1. Assessment of the balance of weighted samples.

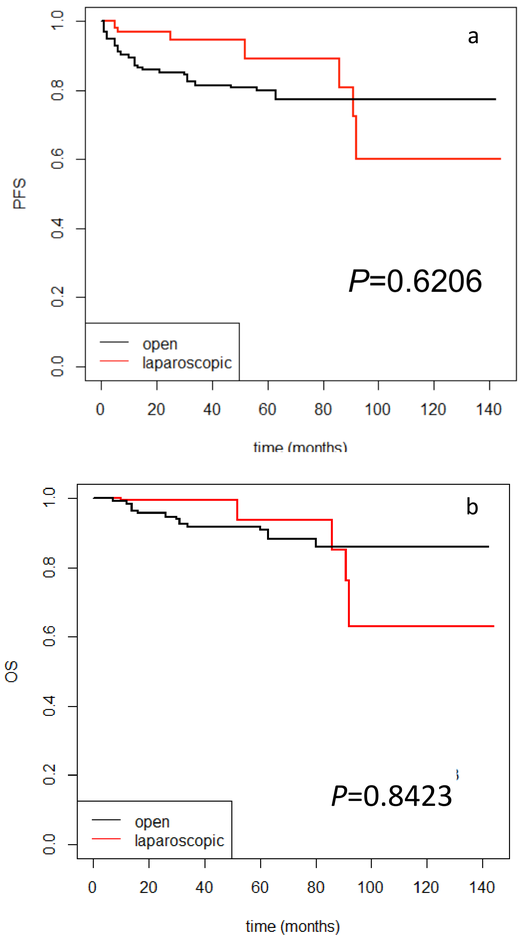

Figure 2. Estimating treatment effect (PFS, a and OS, b) using adjusted Kaplan-Meier estimator and adjusted log-rank test with IPWT (based on PS).

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Results

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Complications (0,1,2, ≥3)

	Multivariable ordinal model			
	Without PS		IPWT based on PS	
Variable	**Coeff. (95% CI)**	**P-value**	**Coeff. (95% CI)**	**P-value**
Age	-	-	-	-
Sex F vs M	-	-	-	-
Positive preoperative PET	-	-	-	-
Tumor size	-	-	-	-
ASA 3-4 vs 1-2	-	-	-	-
Splenectomy	-	-	-	-
MIDP vs OPD	-	-	- 0.629 (-1.085; -0.179)	**0.006**

*Estimated thresholds: -1.035 for 0|1, -0.211 for 1|2, 1.957 for 2|≥3.

Table 1. Final multivariable ordinal models for predicting complications, obtained with a backward procedure for variable selection. From the IPWT model, the class of complications with the highest predicted probability to occur is: **0 with MIDP (prob. = 0.400) vs 2 with OPD (prob. = 0.423).**

Pancreatic fistula

For the analysis of the outcome "pancreatic fistula", no variable was retained in the model after backward variable selection (both without using PS and with the IPWT based on PS) and thus there **was no significant difference in the probability of having pancreatic fistula after ODP in comparison with MIDP** (***P*=0.772**, in the model with IPWT). For this analysis, multivariable logistic regression was employed.

Postoperative length of stay

	Multivariable negative binomial model			
	Without PS		IPWT based on PS	
Variable	**Coeff. (95% CI)**	**P-value**	**Coeff. (95% CI)**	**P-value**
Intercept	*2.387 (2.287; 2.486)*	*< 0.001*	*2.356 (2.293; 2.419)*	*< 0.001*
Age	-	-	-	-
Sex F vs M	-	-	-	-
Positive preoperative PET	0.171 (-0.308; -0.035)	0.014	-	-
Tumor size	-	-	-	-
ASA 3-4 vs 1-2	0.206 (0.032; 0.377)	0.019	-	-
Splenectomy	-	-	-	-
MIDP vs OPD	- 0.264 (-0.406; -0.124)	0.002	- 0.278 (-0.372; -0.184)	**< 0.001**

Table 2. Final multivariable negative binomial models for predicting the postoperative length of stay, obtained with a backward procedure for variable selection. From the IPWT model, the **predicted postoperative length of stay is 11 days with OPD vs. 8 days with MIDP**.

Total number of lymph nodes

	Multivariable negative binomial model			
	Without PS		IPWT based on PS	
Variable	**Coeff. (95% CI)**	**P-value**	**Coeff. (95% CI)**	**P-value**
Intercept	*1.183 (0.821; 1.544)*	*<0.001*	*2.592 (2.458; 2.730)*	*<0.001*
Age	-	-	-	-
Sex F vs M	-	-	-	-
Positive Preoperative PET	0.286 (0.060; 0.513)	0.013	-	-
Tumor size	-	-	-	-
ASA 3-4 vs 1-2	-	-	-	-
Splenectomy	1.434 (1.082; 1.785)	< 0.001	-	-
MIDP vs OPD	- 0.321 (-0.559; -0.080)	0.009	- 0.265 (-0.458; -0.072)	**0.007**
Ki67 (log)	-	-	-	-

Table 3. Final multivariable negative binomial models for predicting the total number of lymph nodes, obtained with a backward procedure for variable selection. From the IPWT model, the **predicted total number of lymph nodes is 13 with OPD vs 10 with MIDP**.